THE PHYTOPHAGOUS INSECT FAUNA ASSOCIATED WITH *ACACIA NILOTICA* SSP. *INDICA* (MIMOSACEAE) IN AUSTRALIA

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Abstract

A survey of the phytophagous insect fauna associated with the exotic weed *Acacia nilotica* ssp. *indica* (Benth.) Brenan was conducted throughout Queensland from 1979-89. Forty-two species, many of which are also associated with native *Acacia* spp., were found on this plant. The more important species included the wattle cicada *Cicadetta oldfieldi* (Distant), that may be implicated in 'dieback' of *A. nilotica*, the seed-feeding bruchids *Caryedon serratus* (Olivier) and *Bruchidius sahlbergi* Schilsky, the cerambycid twig girdlers *Platyomopsis* spp. and *Ancita marginicollis* (Boisduval) and the termites *Mastotermes darwiniensis* Froggatt and *Coptotermes* sp. Two exotic species released during the study period, *B. sahlbergi* in 1982 and the gracillariid *Cuphodes profluens* (Meyrick) in 1983, have not impacted on the abundance of the host plant.

Introduction

Prickly acacia, *Acacia nilotica* ssp. *indica* (Benth.) Brenan, is one of the worst woody weeds of northern Australia and is a 'Weed of National Significance' (Thorp and Lynch 2000). It was introduced into Australia in the 1890s and used as a shade and fodder tree in the early 1900s. It now infests over 7 million hectares of the Mitchell grass downs of western Queensland (Mackey 1997) and has the potential to convert this area from a natural grassland into a woody savannah.

Prickly acacia was recognised as a serious weed after a dramatic increase in its abundance in the mid 1970s, caused by a series of wet years and a switch in enterprises from sheep to cattle, and investigations commenced to find biological control agents. As part of the biological control project, faunal studies of the insects associated with *A. nilotica* have been undertaken in Pakistan (Mohyuddin 1981), Kenya (Marohasy 1995) and South Africa (R. Stals, unpublished). The significance of these and other studies in relation to biological control and collecting technique has been discussed (Marohasy 1995, Palmer 1996). These initiatives led to a number of insects being imported by the Alan Fletcher Research Station for further study and, ultimately, to six species being released in Australia. The six insects were a seed feeding bruchid beetle, *Bruchidius sahlbergi* Schilsky, released in 1982, a tip boring gracillariid moth, *Cuphodes profluens* (Meyrick), released in 1983, a leaf feeding chrysomelid beetle, *Homichloda barkeri* (Jacoby), released in 1996, two geometrid moths, *Chiasmia inconspicua* (Walker) and *C. assimilis* (Walker), released in 1999, and a noctuid moth, *Cometaster pyrula* (Hoppfer), released in 2003.

Before exotic agents are introduced in biological control projects, it is desirable to ascertain the insect fauna (both native and exotic) that has colonised the exotic plant (Harley and Forno 1992). One reason such studies need to be undertaken early in a biological control project is to ensure that the considerable effort and resources necessary to introduce an agent are not wasted on a species that is already present. A second reason is that a faunal study might indicate vacant ecological niches that could be exploited with appropriate introductions. Faunal studies have been conducted in Australia for the exotic leguminous weeds mimosa, *Mimosa pigra* L., which had been colonised by 114 species (Wilson *et al.* 1990), and broom, *Cytisus scoparius* L. (Link), which was colonised by nine species (Memmott *et al.* 2000).

The insect fauna associated with prickly acacia was not known, although the fauna of the Australian acacias has been described in general terms. The insect fauna associated with the Australian *Acacia* spp. is characterized by lacking mutualistic ants, having numerous foliage-mining insects (all Lepidoptera) on the phyllodinous species, having many gall-forming insects from the Eriophyiidae, Cecidomyiidae, Hymenoptera and Thysanoptera, having a number of curculionid but no bruchid seed feeders, and having a rich psyllid fauna (New 1984).

A survey was therefore made of the insects associated with prickly acacia in Australia, which began prior to the introduction of the first biological control agents. The results of this and subsequent surveys made over the next decade, by which time *B. sahlbergi* and *C. profluens* had been released, are reported here.

Materials and methods

Various people in the department undertook the survey over nearly ten years. It commenced in 1979 with a number of dedicated collecting trips to areas infested with prickly acacia. Thereafter the survey was continued opportunistically over the next decade. In this manner, most areas in Queensland infested with prickly acacia were surveyed, including both the Mitchell grass downs (an area roughly bounded by Hughenden, Cloncurry, Winton and Alpha) and the coastal area around Bowen, where severe infestations of the tree also occur.

Insects were collected by visually inspecting the trees or by beating the branches over an insect tray. Prickly acacia is sharply spined which precluded the use of sweeping nets, which would otherwise have been a preferred method of capture. When evidence of internal infestation was present, the plant part was removed and placed in an emergence enclosure to allow the capture of adults. Pods were also regularly collected to allow seed feeders to emerge. Immatures were reared to maturity to obtain adults for identification. Specimens of most species have been retained in the collections at the Alan Fletcher Research Station and details of the collections have been entered into a computer database (Palmer 1995).

All insect specimens were submitted to specialist taxonomists for identification. In many instances, complete identification was not obtained. Often it was not possible to determine whether the insect was actually feeding on *A. nilotica*. We report here all the species belonging to known phytophagous taxa with the exception of pollen and nectar gatherers and adult Lepidoptera and Diptera. The list therefore undoubtedly includes some species that are casual visitors to the plant.

Results

Some 42 phytophagous insect species in five orders and 24 families were collected on prickly acacia with the Coleoptera (59% of species) and Lepidoptera (24%) being well represented (Table 1).

Table 1: Phytophagous insects found on prickly acacia in Qld. (a) - an asterisk (*) indicates the insect was endophagous; (b) - R = rare, O = occasional, C = common.

Species	Life stage collected	Plant part (a)	Freq-uency (b)	Association with native *Acacia* spp.
COLEOPTERA				
Belidae				
Belus semipunctatus (F.)	adult	tip	O	Yes
Bostrichidae				
Bostrychopsis jesuita (F.)	adult	stem*	C	Yes
Xylobisca sp.	adult	stem*	R	
Xylobisca sp. 1	adult	stem*	R	
Bruchidae				
Bruchidius sahlbergi Schilsky	all stages	seed*	C	
Caryedon serratus (Olivier)	all stages	seed*	C	Yes
Buprestidae				
unidentified sp.	adult		R	
Cerambycidae				
Ancita didyma Blackburn	larva, adult	stem*	R	Yes
Ancita marginicollis (Boisduval)	larva, adult	stem*	C	Yes
Ceresium sp.	larva	stem*	R	
Ceresium sp. 1	larva	stem*	R	
Chlorophorus curtisi (L. & G.)	adult	flower	R	
Piesarthrius sp.	larva	stem*	O	
Platyomopsis humeralis (White)	larva, adult	stem*	O	
Platyomopsis sp.	larva, adult	stem*	C	
unidentified sp.				
Chrysomelidae				
Monolepta australis (Jacoby)	adult	leaf	C	

Species	Life stage collected	Plant part (a)	Freq-uency (b)	Association with native *Acacia* spp.
COLEOPTERA (cont.)				
Curculionidae				
Leptopius sp.	adult	tip	R	Yes
Leptopius sp. 1	adult	tip	R	Yes
Leptopius sp. 2	adult		R	Yes
Lixus sp.	adult	flower	R	
unidentified sp.	adult		R	
Rhipiceridae				
Rhipicera neglecta Emden	adult		C	
HEMIPTERA				
Coreidae				
Mictis profana (F.)	all stages	tip	O	Yes
Lygaeidae				
Oxycarenus luctuosus (Mont. & Sig.)				
Scutelleridae				
Coleotichus costatus (F.)	adult	pod	O	Yes
Cicadidae				
Cicadetta oldfieldi (Distant)	nymph, adult	root	C	Yes
ISOPTERA				
Mastotermitidae				
Mastotermes darwiniensis Froggatt	all stages	root, stem	C	
Rhinotermitidae				
Coptotermes sp.	all stages	stem	C	Yes
LEPIDOPTERA				
Gelechiidae				
Mesophleps palpigera (Walsingham)	larva	seed	R	
Geometridae				
Eucyclodes sp. 1	larva	pod	R	
Zermizinga indocilisaria (Walker)	larva	leaf	O	
Oecophoridae				
unidentified sp.	larva	stem*	C	
Pieridae				
Eurema hecabe (L.)	larva	leaf	O	Yes

Species	Life stage collected	Plant part (a)	Freq-uency (b)	Association with native *Acacia* spp.
LEPIDOPTERA (cont.)				
Psychidae				
unidentified sp.	larva	leaf	C	
Pterophoridae				
unidentified sp.		pod	R	
Pyralidae				
unidentified sp.	larva	pod	R	
Tortricidae				
Cryptophlebia ombrodelta (Lower)	larva	pod*, seed	O	Yes
unidentified sp.				
THYSANOPTERA				
Aelothripidae				
Desmothrips sp.	adult	flower	R	
Thripidae				
Frankliniella schultzei (Trybom)	adult	flower	R	Yes
Thrips imaginis Bagnall	all stages	flower	C	Yes

The wattle cicada *Cicadetta oldfieldi* is well known as an associate of native *Acacia* spp. and was found with prickly acacia. The nymphs feed on the roots and emerge from the soil in late summer to shed their final exuviae while attached to a tree trunk. Counts of emergence holes revealed densities as high as 1 hole per 10 cm^2 around the bases of prickly acacia. The adults feed on the tree and oviposit in new growth. This insect has been implicated in a 'dieback' of *A. nilotica* in Australia (Tomley 1995). Adults of a possible parasite of cicada nymphs, *Rhipicera neglecta* (Coleoptera), have also been collected in numbers from prickly acacia and the cicada burrows beneath the trees.

Two bruchids, the imported *Bruchidius sahlbergi* and the cosmopolitan, historically naturalized *Caryedon serratus*, are now commonly found in prickly acacia pods and seeds throughout all areas infested with prickly acacia. The two species can be distinguished by the shape and position of the egg and by the emergence holes from seeds. Eggs of *C. serratus* are laid on the seed or on the side of seed pods and are covered by a pearly white dome, while those of *B. sahlbergi* are yellow and oviposited along the margin of opened pods. *Caryedon serratus* leave the seed as prepupae through irregular, small holes in the seed and spin cocoons outside the seed for pupation. *Bruchidius sahlbergi* pupate inside the seed and adults emerge from a large round hole. Both species are multivoltine and continuous breeders.

The longicorn beetles, *Platyomopsis* spp. and *Ancita marginicollis*, are twig girdlers that were quite commonly encountered. Females chew three or more ringbarks about 1 m from the distal end of branches and insert eggs under flaps of bark near the girdling marks. Girdling results in the death of the branch above the girdles allowing early larval instars to develop unhindered by sap. Later larval feeding below the ringbarking results in the death of the branch above the tunnelled section. The larvae of another longicorn, the acacia borer *Piesarthrius* sp., feed in the sapwood and heartwood of the plant before internally girdling the main stem just above ground level and pupating in the stump.

Branches were attacked by larvae of an unidentified oecophorid wood moth that bore holes into the heartwood in the fork of branches and feed on the bark and sapwood, under a camouflage of chewed up wood and frass webbed together.

At least two termites, the giant termite *Mastotermes darwiniensis* and the smaller *Coptotermes* sp., attack sapwood and heartwood of mature trees. Symptoms of attack are weakening of the tree, branches breaking off, channels of mud throughout the trunk and branches, and loss of leaf cover. The entire tree may fall over during a storm or windy weather.

Although not collected in the field, the cottony cushion scale, *Icerya purchasi* Maskell, has been found on potted plants grown at the Alan Fletcher Research Station and has become a laboratory pest.

Discussion

Exotic, introduced plants invariably have a smaller insect fauna associated with them in their new habitat than they have in their native range (Goeden 1974) and this was also the case with prickly acacia. Some 42 species were found on prickly acacia, whereas the phytophagous insect faunas known from *Acacia nilotica* in Pakistan, India, Kenya and South Africa are now estimated to be at least 69, 64, 116 and over 400 species respectively (W. Palmer, unpublished).

Prickly acacia may well have been one case which did not conform to the general hypothesis that introduced plants have a smaller insect fauna. Australia has a rich flora in the Mimosaceae, particularly in the tribe Acacieae. There are over 1000 endemic taxa in *Acacia* (Cowan 1998) and it might have been anticipated that many insect species found on native congeners would colonise prickly acacia. However, a large number of species was not found on prickly acacia and insects were rarely particularly abundant or damaging. The reason is probably that prickly acacia belongs to the subgenus *Acacia*, which is represented by only nine endemic species, while almost all of the Australian taxa belong to subgenus *Phyllodineae* (Maslin 2001).

A variety of insects colonised prickly acacia after its introduction nearly a century ago. This assemblage includes species attacking the foliage, roots, the trunk and branches and the reproductive parts of prickly acacia. As would be anticipated, many of these insects are generalists associated with other leguminous species.

With the possible exception of the cicada *Cicadetta oldfieldi,* there was little indication that the insect fauna was causing any appreciable effect on the plant populations although, when plants become stressed by drought or other factors, the incidence of secondary attack by longicorn beetles and termites increased. In considering the introduction of further biocontrol agents, it appeared that all niches, with the possible exception of the seed feeders, were underexploited and that it would be undesirable to exclude the agents of any niche from future searches.

Of the six species introduced for biological control, only *Bruchidius sahlbergi,* released in 1982, had clearly established and this insect was regularly found during the latter part of the survey. However, it is now considered to be having little impact (Radford *et al.* 2001). The gracillariid *Cuphodes profluens* (Meyrick), released in 1983, was not seen during this survey and is now thought not to have established. The other four species, *Homichloda barkeri, Chiasmia inconspicua, C. assimilis* and *Cometaster pyrula*, were released after the conclusion of the survey.

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